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KOREA INSTITUTE OF SCIENCE AND TECHNOLOGY CONTRIBUTION TO KOREA'S INDUSTRIAL DEVELOPMENT 1/

by

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Korea Institute of Science and Technology
Contribution to Korea's Industrial Development

Ten years have elapsed since the Korea Institute of Science and Technology(KIST) was established and registered as the only independent non profit research organization of the Republic of Korea by President Park Chung-hee on February 10, 1966. During this period, KIST has endeavored a great deal to contribute to the development of industrial technology, as set forth in its Articles of Incorporation.

In the past decade, the Korean economy was so industrialized that the share of secondary industry in GNP rose from 15.9 per cent to 33.0 per cent and that the weight of heavy and chemical industries in the manufacturing sector increased from 26.4 per cent to 34.2 per cent (1974). In this development process, KIST so contributed to the development of industrial technology as to let industry feel the need for research and development investment for its future growth and the academic community recognize the importance of applied research. This promoted personnel exchange between KIST and industry and academic institutions to contribute to industrialization process. (see Table 1, 2)

Table 1. Trends in Korea's industrial structures (1966-1975)

Year	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Primary industry	38.9	34.3	31.1	30.5	28.0	26.5	25.2	22.8	22.2	21.9
Secondary industry	15.9	18.2	20.0	20.8	22.8	24.4	26.2	29.4	31.7	33.0

Year	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Tertiary industry	45.2	47.6	48.9	48.7	49.2	49.1	48.6	47.8	46.1	45.1
All industry	100 0	100.0	100.0	100.0	100 0	100.0	100.0	100.0	100.0	100.0

Data: Korea's per capita income (Bank of Korea 1975)
Korea Economic Almanac (Korea Businessmen's Federation)

Table 2. Trends in Korea's industry (1966-1974)

Year	1966	1967	1968	1969	1970	1971	1972	1973	1974
Petro-chemistry	11.3	12.1	15.7	16.0	17.6	17.8	16.3	15.1	13.7
Metal	4.2	4.1	4.1	3.9	3.7	3.4	3.2	3.8	4.2
Machinery	10.9	11.9	12.3	13.0	10.7	9.7	9.8	12.7	16.3
Food	24.3	23.6	20.7	21.2	20.5	20.4	19.2	16.6	15.0
Fiber	14.8	14.4	14.2	14.4	14.7	14.6	16.2	15.2	13.1
Other	34.5	33.9	33.0	31.5	32.8	34.1	35.3	36.6	37.7
All manufacturing industry	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Heavy and chemical industry ratio	26.4	28.1	32.1	32.9	32.0	30.9	29.3	31.6	34.2

Data: Korea's per capita income (Bank of Korea 1975)

* : Heavy and chemical industries include Petro-chemistry, metal industry and machinery industry only.

Heavy and chemical industry ratio=value added of heavy and chemical industries/Value added of all manufacturing industry

1. KIST Achievements in 10 Years

KIST is categorically different from conventional research institutes in that it is a contract research organization. As a result, it places the upper most emphasis on project development to win research contracts from the industry.

At the time of KIST establishment, some people expressed deep concern about the possibility of winning research contracts from the industry. In a developing country like Korea, can industry ensure the development of a contract research system so sufficiently as to necessitate the existence and growth of a contract research organization like KIST? Investment in research and development was then considered risky, and Korean industry, in the initial stage of development, was considered as being incapable of spending money on research and development. On this consideration, the establishment of a contract research institute was then looked on by many people with anxiety.

However, KIST put away such anxiety through its brisk activities. It won ever increasing research contracts from the Government as well as industry (see Fig. 1). Up to the end of June 1976, KIST was awarded a total of 1,390 contracts to the tune of some 13.3 billion won. In 1975 alone, it won 231 contracts totaling 3.36 billion won, 12 per cent of the total research spending of the country in the year. Noteworthy is the fact that research contracts awarded by industry are on sharp increase, and such contracts accounted for 27.1 per cent of the total research funds spent by industry in 1974 (see Table 3).

Table 3. Total research cost by industry and KIST research volume shared by industry

(Unit: ₩ 1 mil.)

Year	1967	1968	1969	1970	1971	1972	1973	1974	1975
Total research cost by industry (A)	795	992	1,777	3,0[illegible]	2,969	3,835	6,94[illegible]	5,035	-
KIST research volume shared by industry (B)	7	49	88	139	307	627	1,289	1,366	2,313
Ratio (B/A) %	0.9	4.9	5.0	4.6	10.3	16.3	18.7	27.1	-

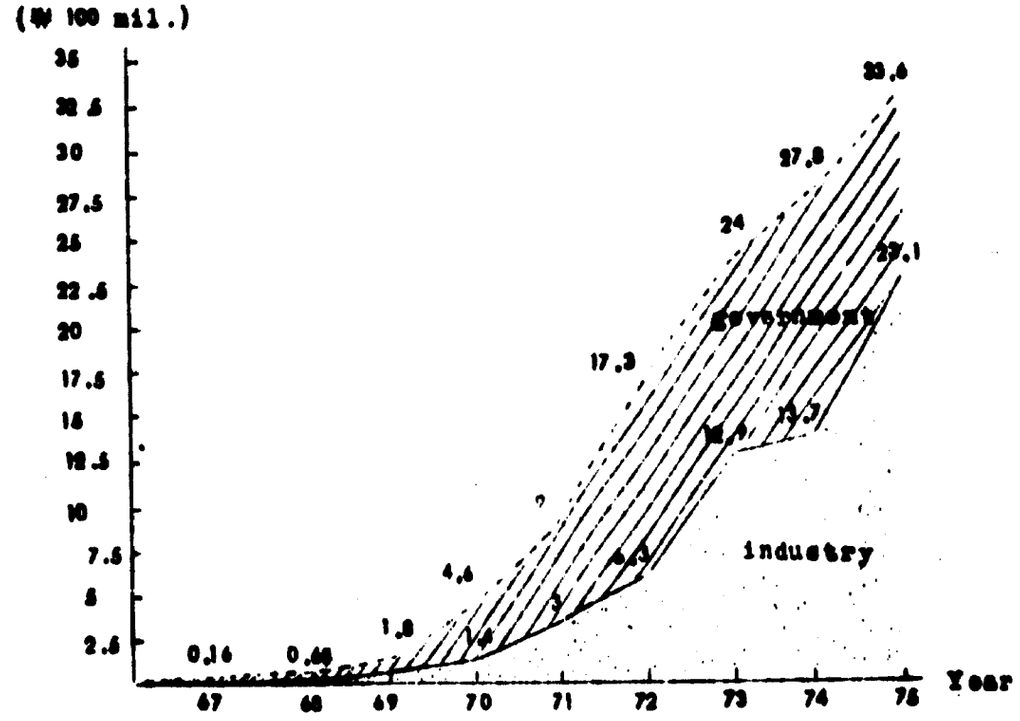


Figure 1. Research Volume by Year

Research contracts in such areas as heavy and chemical industries as electricity, electronics, machinery, chemicals and metallic materials accounted for 60 to 70 per cent of the total research contracts, reflecting the increasing weight of these industries in Korea's industrial structure and the direction of Korea's industrialisation process. (see Table 4).

Table 4. Research contracts by field (Unit: W 1 mil.)

Year	1967	1968	1969	1970	1971	1972	1973	1974	1975
Heavy and chemical industries	7 (43.8)	47 (68.1)	133 (72.3)	282 (61.8)	513 (56.7)	1,171 (67.7)	1,536 (64.3)	1,645 (59.0)	2,194 (65.4)
Electricity & electronics		9	49	90	139	289	265	474	476
Chemistry & chemical engineering	5	11	23	62	137	200	460	356	560
Machinery		8	27	98	154	559	707	475	930
Metallurgy	2	19	34	32	83	123	104	341	228
Others	9	22	51	174	391	558	854	1,143	1,163
Total	16 (100.0)	69 (100.0)	184 (100.0)	45 (100.0)	904 (100.0)	1,729 (100.0)	2,390 (100.0)	2,788 (100.0)	3,357 (100.0)

* : Figures in parenthoses indicate %.

In the past decade, some 400 industrial establishments sponsored KIST research projects under contract. This number is more than 10 per cent of the total number of relatively large business establishments in the manufacturing sector. If the number of the establishments

which awarded KIST some 6,000 small contracts on chemical analysis, material testing, machine-design and processing and use of KIST equipment is added, the number of KIST clients will greatly increase.

Research contracts related to applied and development research on new products and processes numbered 599 (see Table 5). About half of the results of these research projects have been either applied to production on a commerical level or ready for commercialization.

Table 5. Research Contracts by Nature (as of the end of 1975)

Nature	Number of contracts	Amount of contracts(₩1 mil.)	Composition Ratio (% in amount)
Survey	191	793	6.7
Basic research	17	42	0.4
Applied research	193	1,130	9.5
Development research	406	5,685	47.7
Technical management	51	507	4.3
Others	408	3,749	31.5
Total	1,266	11,906	100.0

As seen in Table 6, research contracts KIST has been awarded in the past decade are fairly balanced among the areas of industrial technology selected for intensive research and development at the time of KIST establishment.

Table 6. Research Contract Status by Field (as of the end of 1975)

Field	Number of contracts	Amounts of contracts(₩1 mil.)	Ratio (% in amount)
Electricity and Electronics	181	1,790	15.0
Machinery	124	2,959	24.9
Chemistry and Chemical engineering	201	1,815	15.2
Food and Biotechnology	105	602	5.1
Metallurgy	136	972	8.2
Computer System	312	2,360	19.8
Others	207	1,408	11.8
Total	1,266	11,906	100.0

KIST research activities have changed in a diversified manner according to the development stage of the Korean economy. A few typical cases of KIST research activities will be introduced in the following.

Polyester Yarn Spinning Process: Late in the 1960's, a certain company imported textile equipment of spinning polyester yarn, and with the equipment in normal operation after successful test run, the company was confronted by the problem of falling product quality and capacity operation rate. A foreign engineering firm demanded $200,000 for solution of this problem. The company then brought the problem to KIST, and KIST tackled it, sending a team of scientists and engineers in polymer, mechanical engineering, electrical

instrumentation and chemical analysis to the company. The KIST team found in the on-the-spot examination that the problem was due to wrong instrumentation and the rope between polyester filaments and solved it at a cost of only $3,000. As a result, the company could increase the production of A-Class yarn from 20 per cent to 90 per cent and the capacity operation rate from 30 per cent to 130 per cent of the designed capacity. This was a typical case of KIST assistance in industry's adaptation of imported technology for successful application.

Carbon Fluoride Process: KIST adapted and developed the process of manufacturing carbon fluoride originally developed in the United States for application to local production of the item, using fluorite which is produced in abundance in the country. After construction and test run of a pilot plant of this process capable of producing 5 tons a month, KIST provided enigneering data on construction and operation of a commercial plant of producing carbon fluoride for industry, which is now constructing a factory capable of producing 2,000 tons a year, using the KIST data. This factory, when dedicated in 1978, is expected to replace the imports of carbon fluoride which now amounts to about $4 million a year. This is an example of KIST modification of existing technology for commercialization in the country.

Ethambutol Process: Korea imported $600,000 worth of ethambutol in 1971, and for this drug for tuberculosis was on the increase then. KIST started to develop a process of manufacturing this drug for local production. KIST scientists first developed a process of synthesizing 2-amino-butanol and then a process of synthesizing

ethambutol using 2-amino-butanol on a bench scale. This led to construction of a pilot plant in a joint venture with industry to produce ethambutol on a trial basis. Then a commercial plant was constructed on the basis of the data obtained from the pilot plant and it is now producing the drug to meet the domestic demand. This is a case of successful development of a new process for commercialization, and it helped the pharmaceutical industry of the country slough off the stage of producing drugs with imported materials and packing them so as to become a self-sufficient industry.

Pocket-size Calculator: KIST developed a new model of desk-top calculators, which first appeared on the world market in early 1970, on the basis of new specifications of parts and components and a new circuit design. The KIST-developed calculator was first exported to the United States in 1972. KIST continued to develop new models producible at a lower cost, and these models are now successfully competing with foreign products on the world market. In 1975, exports of KIST-developed models totaled $10 million. This is a case of successful development of a new product for commercialization on the basis of an accurate demand forecast. The company producing KIST-developed pocket-size calculators is now capable of developing new models as a result of KIST technical assistance.

2. Industry's Reaction to KIST

How does industry use KIST research results and how does KIST meet industry's technical needs?

A survey of 123 industrial establishments which sponsored a total of 184 research projects at KIST revealed that 91.9 per cent of the total projects were considered as satisfactory or fair and 8.1 per cent were regarded as unsatisfactory. Projects considered to have achieved the objective accounted for 96.2 per cent and those considered to have failed to achieve the goal were 3.8 per cent. Those considered to have contributed to the development of new technology and the improvement of technology were 64.1 per cent. While 92.4 per cent were considered reasonable with respect to research cost, 3.3 per cent were considered too expensive. (see Table 7).

Table 7. Survey of industry reaction to research results

(Unit: No. of projects)

Reaction \ Area		basic research	applied research	development research	survey	technical management	Others	Total (%)
Degree of satisfaction	Satisfactory	0	17	16	33	19	25	110 (59.8)
	Fair	2	21	30	3	1	2	59 (32.1)
	Unsatis-factory	0	5	9	0	0	1	15 (8.1)
	Sub total	2	43	55	36	20	28	184 (100.0)
Degree of purpose fulfilment	Fulfilled	1	18	22	34	18	26	119 (64.7)
	Fair	1	21	30	2	2	2	58 (31.5)
	Unfulfilled	0	4	3	0	0	0	7 (3.8)
	Sub total	2	43	55	36	20	28	184 (100.0)

Degree of contribution \ Area	basic research	applied research	development research	survey	technical management	Others	Total (%)
New technology development	2	19	39	1	2	4	67 (36.4)
Technical improvement	0	12	9	12	10	8	51 (27.7)
Sales policy	0	2	2	4	0	0	8 (4.3)
Planning	0	2	0	16	8	14	40 (21.8)
Others	0	8	5	3	0	2	18 (9.8)
Sub total	2	43	55	36	20	28	184 (100.0)

Projects which drew the reaction of explicit and implicit discontent from the sponsors with respect to research results numbered 26, and the reasons for such reaction were as follows:

a. Difficulty in demand development (market development)	11	projects	(42.3%)
b. Short supply of raw materials	6	"	(23.0%)
c. Suspension of project due to short R and D budget	2	"	(7.7%)
d. Insufficient research report	2	"	(7.7%)
e. Failure to carry out part of project due to too broad project scope	1	"	(3.8%)
f. Insufficient research progress due to lack of sponsor's cooperation	1	"	(3.8%)
g. Others	2	"	(7.7%)
Total	26	"	(100.0%)

Of the above reasons, KIST should support industry in market development, in addition to technical assistance.

It sometimes happens that project sponsors cannot receive KIST technical assistance because of their low technical level, but KIST should make an effort to extend technical aid suitable to the technical condition of its clients. In other words, KIST-developed technology must be sufficient enough to be adapted by sponsors. In addition, KIST must persuade sponsors to extend their research contracts so that they may receive the technology they want.

As for the problem of economic feasibility, KIST should also assume responsibility because KIST is supposed to sign a research contract on the basis of the judgement that the contract is economically feasible. But because of change in the economic situation of the country and abroad while the project is in progress, the economic feasibility of the project may fall inevitably. It is therefore recommendable for KIST to be more careful about economic feasibility study.

KIST experience tells that industry wants not only research reports but also assistance in the whole process of commercialization of research results from KIST.

3. Direction of Future KIST Development

In addition to its mission as an industrial research institute, KIST has played the role of a think-tank providing support in the establishment of Government economic and scientific policies, and it should continue to play this role in the future. In its initial years of operation, KIST conducted surveys of long-term energy supply and demand, machinery

industry development, electronics industry development and development of graduate education of science and engineering. It also took positive part in the preparation of industrial development programs under the Fourth Five-Year Economic Development Plan starting 1977.

The future course of action KIST should pursue will be determined by changes in the economic situation of the Country and the experience it has accumulated so far. But the following three tasks are expected to face KIST in the years to come.

First, KIST will be required to provide active assistance for the import of advanced technology and the adaptation and development of imported technology for successful adaptation by domestic industry.

The Korean economy is rapidly developing today. In order to sustain the rapid growth of the economy, industrial technology must also develop rapidly. This requires the import of advanced technology on a relevance basis. In other words, KIST is expected to play a vital role in technology transfer from advanced countries even more actively.

This means that KIST will cast off the passive posture in the development of industrial technology, that is, research for solution of technical problems at industry's request. Instead, it will assume a positive attitude, that is, to play the leading role in the import of technology on the basis of industrial technology demand forecasts and adapt and develop imported technology for transfer to industry. For example, KIST will import such key elements of semiconductor technology as automatic lamination, mask automatic design and ion plantation,

and develop microprocessor, and monolithic LED on the basis of such processes for transfer to industry.

Second, the Technology Transfer Center, established on February 10, 1976, will be strengthened. In order to support the rapid growth of the Korean economy based on the development of heavy and chemical industries, it is necessary to develop industrial technology rapidly, as mentioned above, and this can be achieved with imported technology playing the leading role. TTC is designed to help industry import appropriate technology and adapt and develop such technology for successful application to production. In other words, it will help industry identify and import the technology it badly needs on favorable conditions and terms through its technical counseling program. It will also provide assistance in industry's efforts to adapt and develop imported technology through its after-import follow up.

The technical information networks KIST is now organizing and the technical capability it has developed on the basis of experience and knowledge accumulated in the past decade will enable KIST to provide effective assistance in a systematic and efficient import of advanced technology into the Country.

Third, KIST should accelerate commercialization of research results by use of the Korea Technology Advances Corporation established with 100 per cent KIST investment on September 9, 1974. This will solve two problems facing KIST -- the problem of inactive commercialization of research results due to the lack of an adequate entrepreneurship and the finance.

Experience tells that business cannot thrive with technology only. Management capability and other non-technological factors are as equally important as technology in business. K-TAC studies research results in an objective manner, that is, from the viewpoint of a businessman, and prepares a concrete plan for commercialization of research results on the basis of such study. Then it selects an appropriate company capable of commercialising the studied research result or establish a joint venture firm with it for commercialization, or construct a factory at its own cost and sells it to industry as a package-deal after commercialisation proves successful in such a factory.

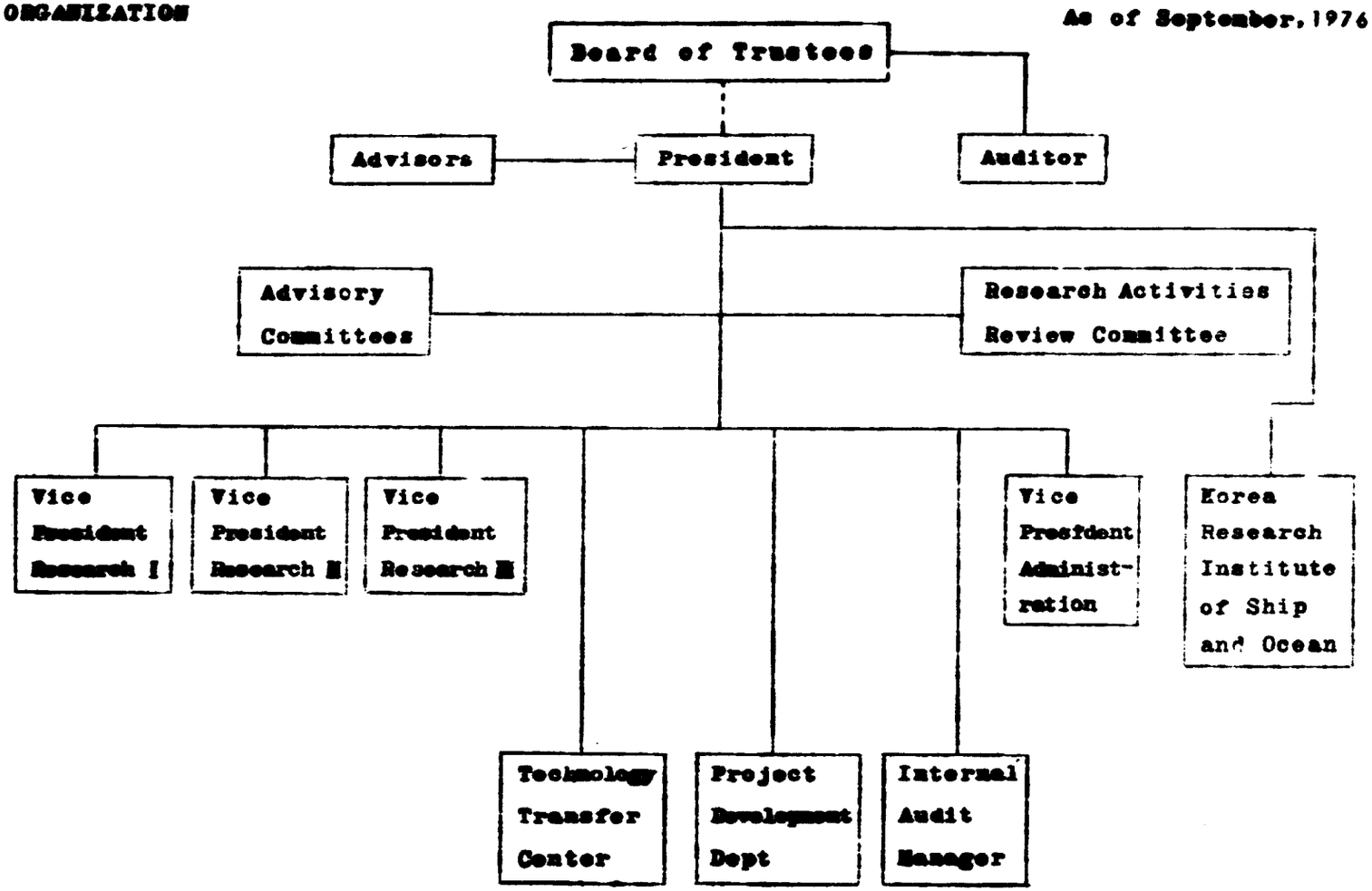
Through K-TAC, KIST can accelerate commercialisation of research results and develp new research projects urgently required by industry. In addition, marketability study of new products will be possible through sales of experimental products and side products of research projects.

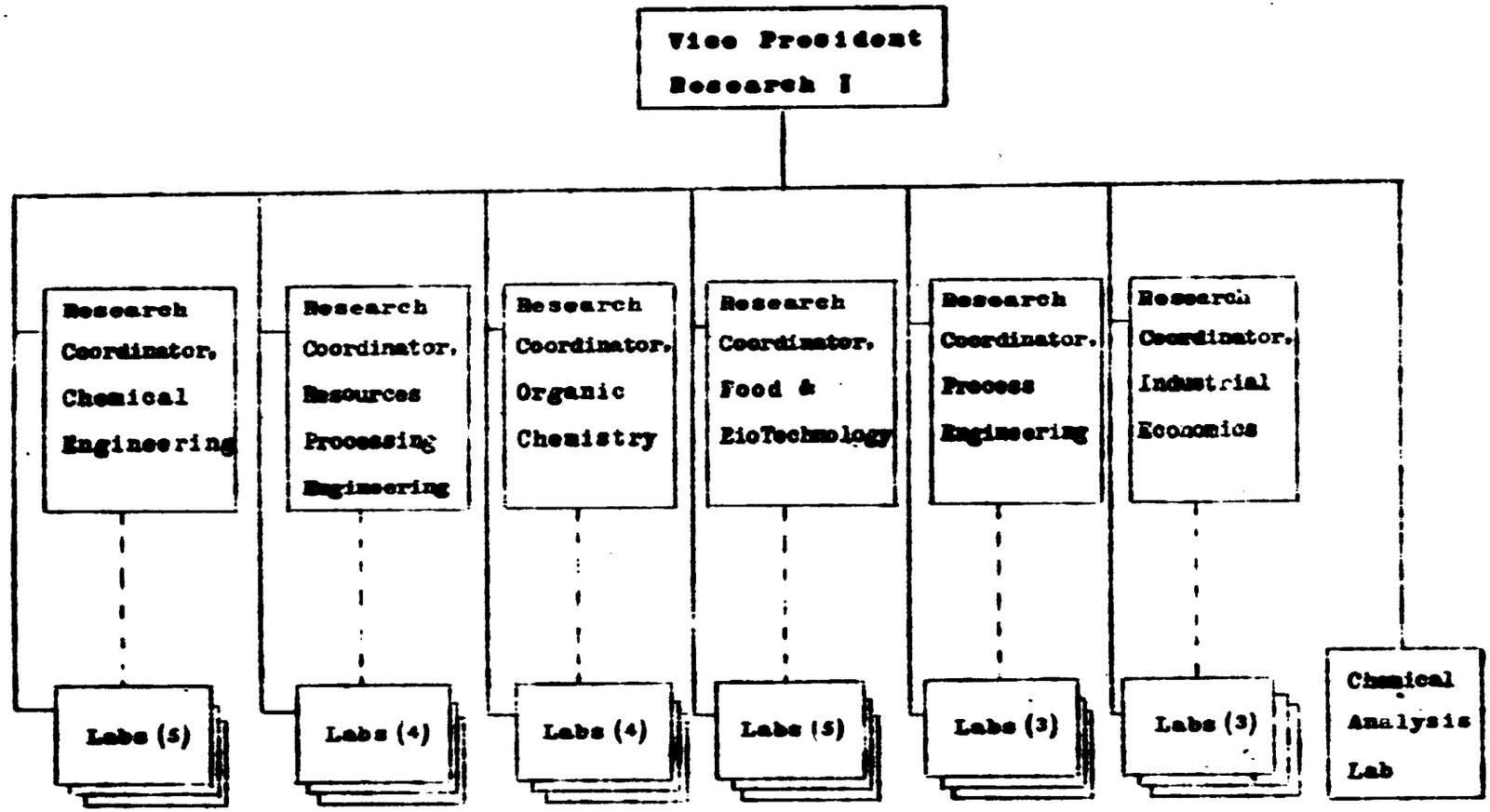
K-TAC has established four companies -- two in joint venture with local business firms, one in joint venture with a foreign firm and one with direct investment. These companies are now constructing factories, and two pilot plants are being constructed directly by K-TAC. In the years to come, K-TAC will establish three to four new firms in the form of joint ventures, holding company or direct investment every year in order to insure successful transfer of KIST-developed a imported technology to industry, and if all goes smoothly, K-TAC will make businesses profits amounting to 300 million won to one billion won a year in five to 10 years.

KIST will continue to be a think-tank, providing solution to national problems in cooperation with experts both at home and abroad. It will strengthen ties with industry and unite its research and development capability, TTC's technical information services and K-TAC's capability to commercialize research results into an integral system in order to be a national center for industrial technology development.

ORGANIZATION

As of September, 1976.

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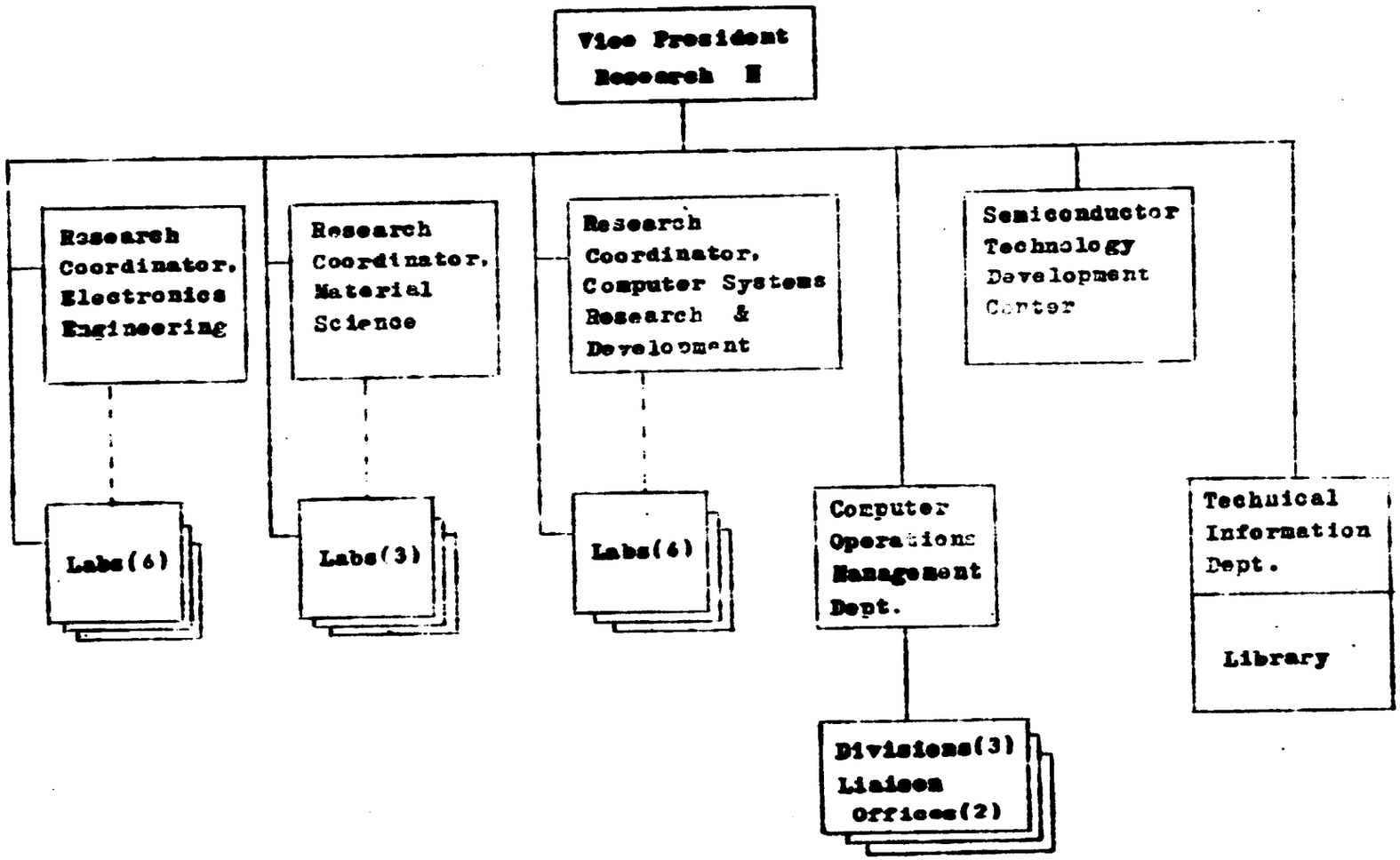
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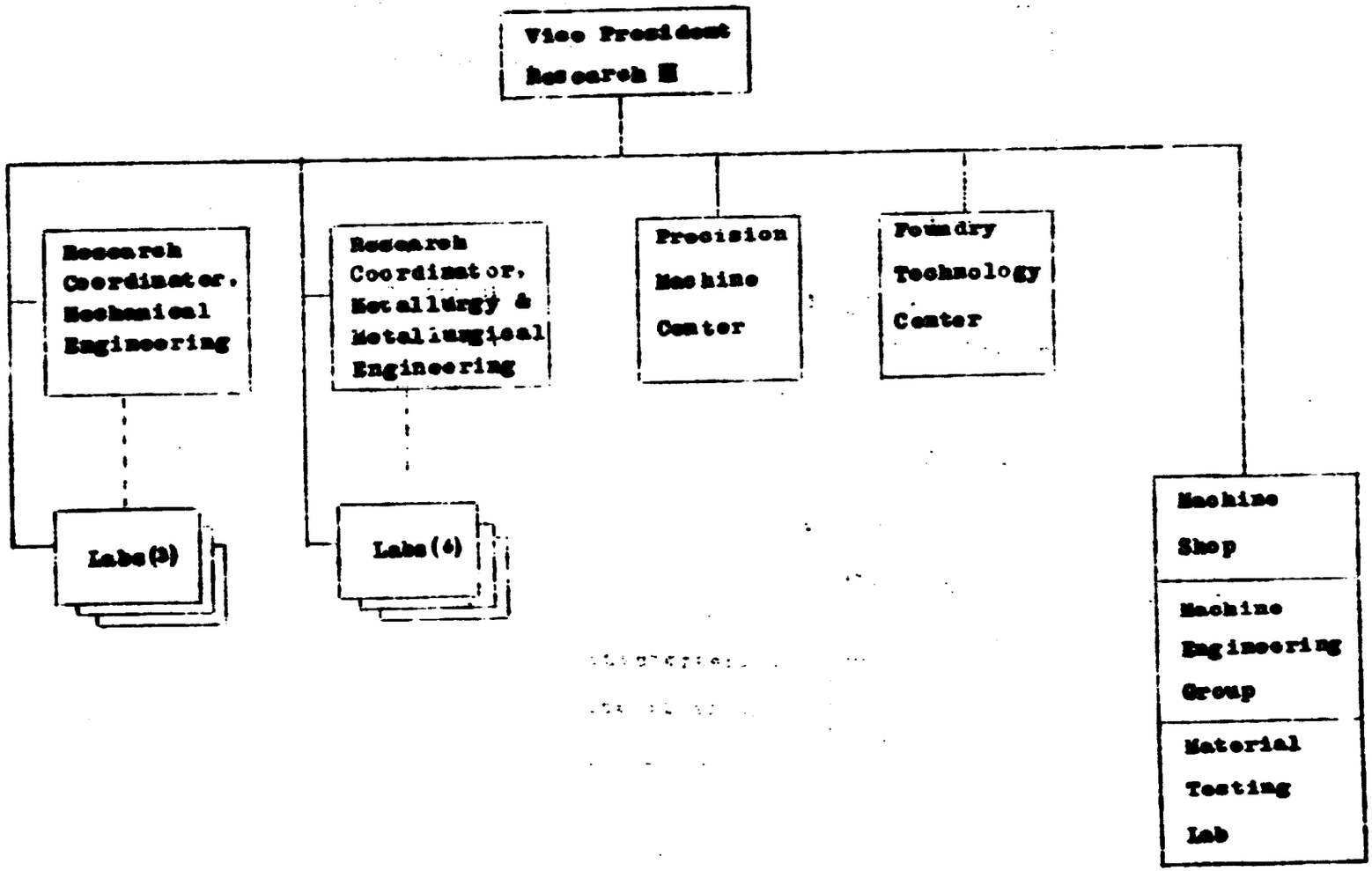
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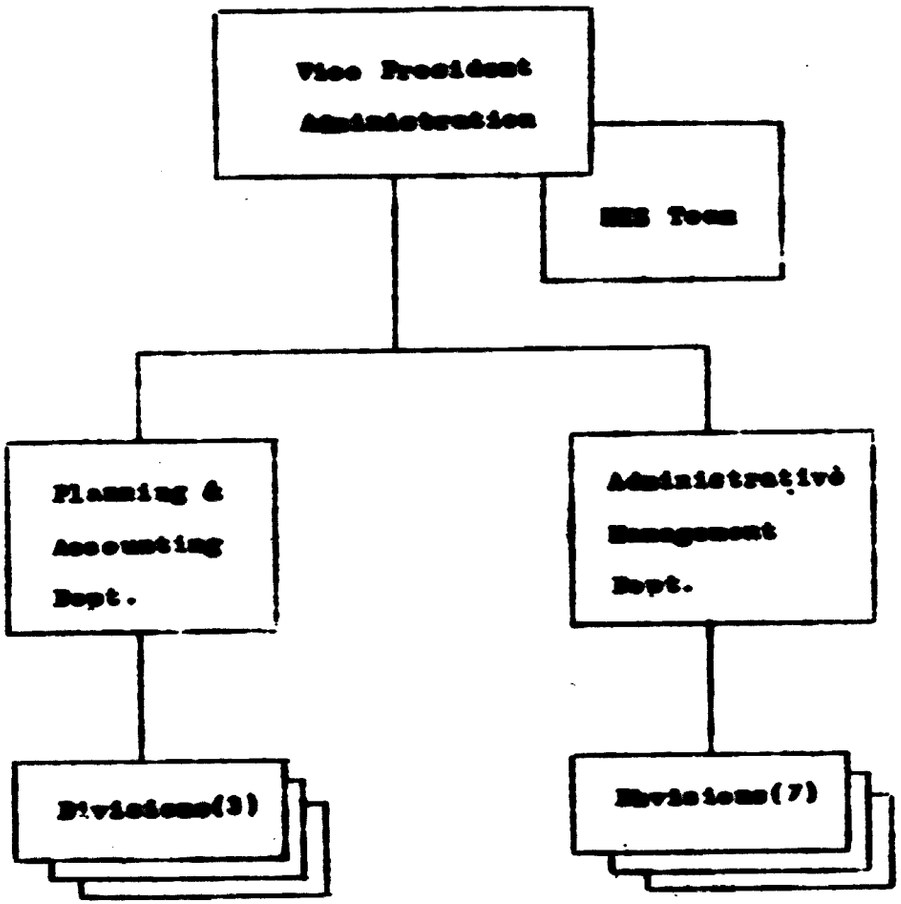
Material Testing Lab


Vice President
Administration
MIS Team
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Dept.
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Divisions(7)

Status of Research Personnel

As of September, 1976

Research Field \ Degree	Ph.D.	M.S.	B.S.	Others	Total
Chemical Eng.	7	13	7	21	48
Resources Processing Eng.	5	5	3	9	22
Organic Chemistry	7	6	8	9	30
Food & Biotechnology	7	14	5	23	49
Process Eng.	2	7	14	27	50
Industrial Economics	2	12	12	7	33
Electronics Eng.	4	4	17	39	64
Material Science	5	5	17	27	54
E.D.P.S.	4	12	81	72	169
Mechanical Eng.	1	4	24	60	89
Metallurgy & Metallurgical Eng.	6	9	19	21	55
Others	7	5	38	23	73
Ship & Ocean	5	15	51	20	91
Total Research Personnel	62	111	296	358	827
Admin Personnel					242
Total					1,069

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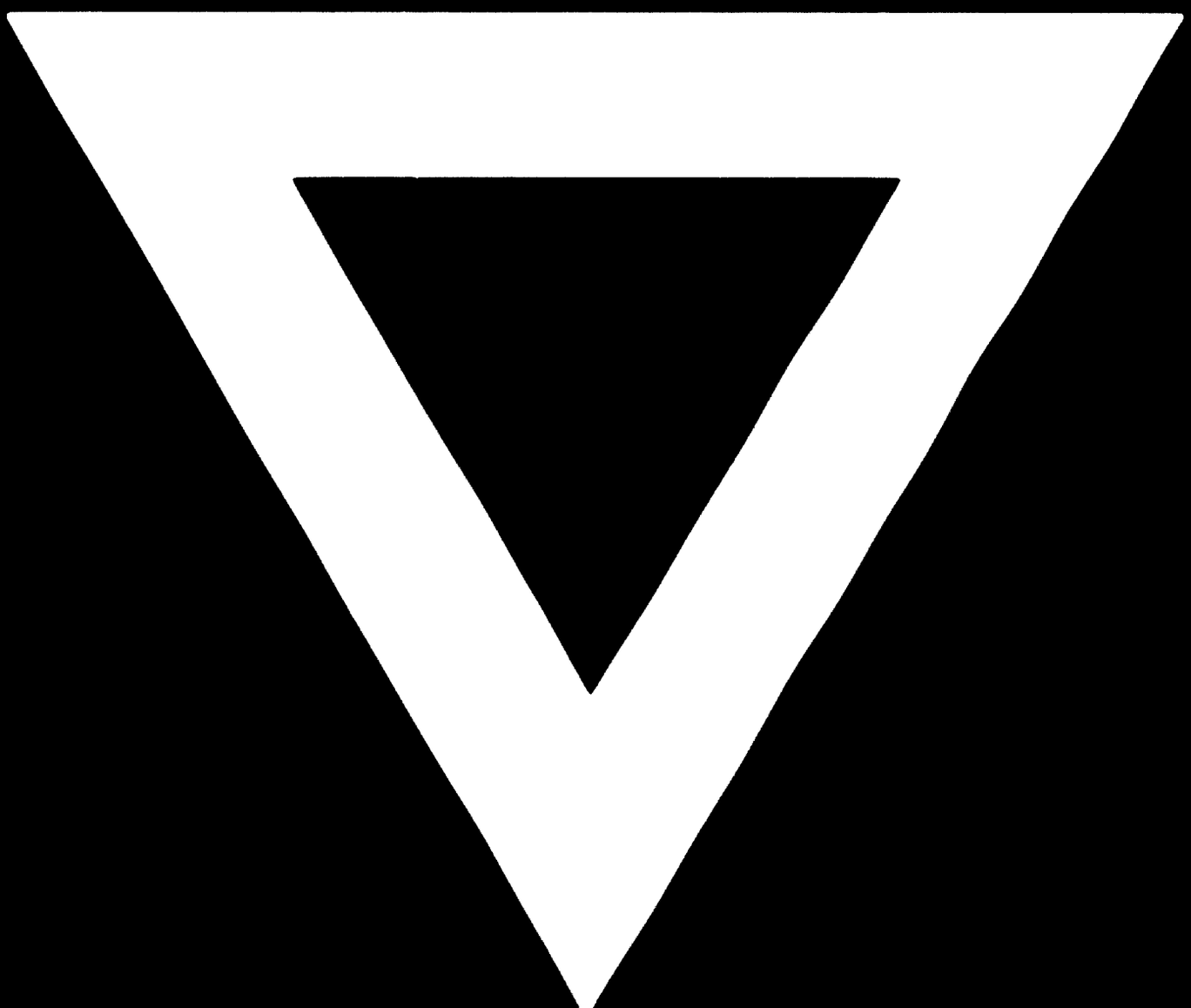

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